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A REVIEW OF THE AMERICAN GASTEROSTEIDÆ.

BY CARL H. EIGENMANN.

In this paper I have attempted to give the synonymy of the American species of *Gasterosteidæ* with analytical keys for their identification, and such notes as my studies of the group seem to justify. The specimens examined all belong to the Museum of the Indiana University.

I am indebted to Dr. David S. Jordan for the use of his library and for many suggestions.

Analysis of Genera of Gasterosteidæ.

- a. Snout not prolonged; dorsal spines 3 to 11.
- b. Innominate bones joined, forming a median plate on belly behind ventral fins.
- c. Gill membranes joined; their posterior border free from the isthmus; spines small, mostly feeble.
- d. Dorsal spines 7 to 11, weak, divergent; innominate bones with the outer edge stout and thick; the median part scarcely ossified; pubic bones long, weak, widely divergent, leaving a <-shaped naked area in front of ventral spines; body slender. PYGOSTEUS. 1.
- dd. Dorsal spines 5, non-divergent, of moderate size; innominate bones united, forming a short, narrow but strong ventral plate; pubic bones weak, short, widely divergent, leaving a subcircular space in front of ventral spines; body rather stout; skin smooth. EUCALIA. 2.
- cc. Gill membranes narrowly joined to the isthmus; innominate bones large and strong; spines of fins mostly strong; divergent; dorsal spines 3 or 4 in number; pubic bones very broad, long and little divergent, leaving a lanceolate-shaped, naked area in front of the ventrals; form robust; skin mailed or naked. GASTEROSTEUS. 3.
- bb. Innominate bones not joined, but each extending as a strong process under the skin on outside of insertion of ventrals; the area between them flat and not ossified; pubic bones short and weak, not visible externally; dorsal spines strong, divergent, 4 in number; gill membrane broadly joined to the isthmus; body rather stout; the caudal peduncle very slender; skin smooth. APELTES. 4.

- aa.* Snout projecting, subtubiform; dorsal spines small, about 15; innominate bones joined only at base; body elongate; sides mailed. SPINACHIA. 5.

1. PYGOSTEUS.

Pygosteus (Brevoort MSS.) Gill, Cat. Fish. East Coast N. A., 39, 1861. (Not characterized); Canadian Naturalist, ii, 8; August, 1865 (*occidentalis*).

Gasterosteus Sauvage, Revision des Epinoches, 29, 1874 (*pungitius*).

This genus is characterized by the presence of 7 to 11 divergent dorsal spines and by the weakness of the innominate bones. It differs from *Gasterosteus* also, in having the posterior margin of the gill membrane free and by the less development of the spinous armature.

But a single species, variable in its characters, seems to be known. It is widely distributed in the fresh and brackish waters of northern regions.

Analysis of Species of Pygosteus.

- a.* Body extremely elongate and slender, deepest at ventral spines, decreasing in height towards head and tail. Head long, 4 in length to base of caudal. Mouth large, very oblique; maxillary not reaching to anterior margin of orbit. Teeth small, in a single series. Eye large, its diameter greater than snout. Caudal peduncle keeled, slender and long, about 5 in length to base of caudal. No bony plates along side; small plates extending along the bases of the anal and soft dorsal. Post pectoral plate present, large and faintly granulate. Scapula forming a triangular post opercular plate; operculum striate. All the surface bones very weak, bones of skull granulate; innominate bones weak, translucent, thin in the median part. Gill openings extending to below posterior edge of preopercle. Vertebrae (*pungitius*) 14 + 18. Caudal fin lunate, long and narrow.
- b.* Ventral spines more than one-third of head. D. VII. to IX-1, 9; A. 1, 8. PUNGITIUS. 1.
- bb.* Ventral spines less than one-third length of head. D. X-I. 10; A. I, 10. BRACHYPODA. 1 (*a.*)

1. PYGOSTEUS.

1. *P. pungitius*.

Gasterosteus aculeatus in dorso decem Artedi, Gen. Pisc., 52, 1738.

Gasterosteus pungitius Linnæus, Syst. Nat., Edit. x, L. 296, 1758 (based on Artedi) (and of European authors generally); Storer, Rept. Fish. Mass., 32, 1839 (Salem); Bean, Proc. U. S. Nat. Mus., 1879, 10 (Boston); Goode & Bean, Fish. Essex Co. and Mass. Bay, 5, 1879 (Salem Pond); Bean, Proc. U. S. Nat. Mus., 1880, 77 (Wood's Holl); Bean, Proc. U. S. Nat. Mus., 1881, 128 (Hudson Bay); Jordan and Gilbert, Syn. Fish. N. A., 393, 1883; Stearns, Proc. U. S. Nat. Mus., 1883, 124 (Labrador).

Pygosteus pungitius Forbes, Bull. Ill. Lab. Nat. Hist., iii, 69, 1880 (Calumet R.; Lake Michigan); Jordan, Ohio Geol. Rep., 999, 1882 (Name only); Jordan, Cat. Fish. N. A., 63, 1885.

Gasterosteus pungitivus Walbaum, Artedi Piscum, 446, 1792 (After Artedi).

Gasterosteus occidentalis Cuvier & Valenciennes, Hist. Nat. Poissons, iv, 509, 1829 (Newfoundland); Dekay, Nat. Hist. N. Y., 68, plate XLII, fig. 135, 1842 (New York); Jordan, Cat. Freshwater Fish. U. S., 441, 1878 (Name only).

Gasterosteus pungitius var. *occidentalis* Günther, Cat. Fish. Brit. Mus., i, 6, 1859 (North America).

Pygosteus occidentalis (Brevoort MSS.) Gill, Cat. Fish. East Coast N. A., 39, 1861 (East Coast); Gill, Cat. Fish. East Coast N. A., 16, 1873 (Name only); Jordan, Man. Vert., 248, 1876 (Great Lakes); Goode, Bull., xiv, U. S. Nat. Mus., 53, 1879 (Name only); Goode, Bull. xxi, U. S. Nat. Mus., 31, 1880 (Name only).

Gasterosteus occidentalis Sauvage, Revision des Epinoches 30, plate i, fig. 18, 1874 (Newfoundland).

Gasterosteus concinnus Richardson, "Fauna Bor. America. iii, 57," 1836 (Saskatchewan and Mackenzie Rivers); Dekay, Nat. Hist. N. Y., 68, 1842 (Northern regions); Günther, Cat. Fish. Brit. Mus., i, 6, 1859 (copied).

Pygosteus concinnus Jordan & Copeland, Checklist N. A. Fresh Water Fish., 40, 1876; Jordan, Cat. Fresh Water Fish N. A., 441, 1878 (Name only).

Gasterosteus concinna Sauvage, Revision des Epinoches, 35, 1874 (Name only).

Gasterosteus mainensis Storer, Boston Journal Nat. Sci., i, 465, 1837 (Kennebec Co., Maine); Dekay, Nat. Hist. N. Y., 68, 1842 (copied); Günther, Cat. Fish. Brit. Mus., i, 6, 1859 (copied); Sauvage, Revision des Epinoches, 33, 1874 (copied).

Pygosteus mainensis Jordan & Copeland, Checklist N. A. Fresh Water Fish., 140, 1876 (Name only); Jordan, Cat. Fresh Water Fish N. A., 441, 1878 (Name only).

- Pygosteus occidentalis* var. *mainensis* Jordan, Man. Vert., 248, 1876 (Kennebec Riv.).
- Gasterosteus nebulosus* Agassiz, Lake Superior, 310, plate iv, fig. 4, 1850 (Lake Superior).
- Pygosteus nebulosus* Jordan, Fish. Indiana, 31, 1874 (Lake Michigan); Jordan and Copeland, Checklist N. A. Fresh Water Fish., 140, 1876 (Name only); Nelson, Bull. Ill. Lab. Nat. Hist., i, 42, 1877 (Lake Michigan).
- Pygosteus occidentalis* var. *nebulosus* Jordan, Man. Vert., 248, 1874; Jordan, Bull. Ills. Lab. Nat. Hist., ii, 51, 1877 (Lake Michigan); Jordan, Cat. Fresh Water Fish. N. A., 441, 1878 (Name only).
- Gasterosteus dekayi* Agassiz, "Lake Superior, 311," 1850 (after Dekay); Putnam, "Proc. Essex Inst., 148, 155;" Putnam, Bull. Mus. Comp. Zool. i, 11, 1863; Storer, Hist. Fish. Mass., 91, plate viii, fig. 3, 1867 (Massachusetts).
- Pygosteus dekayi* Gill, Cat. Fish. East Coast N. A., 39, 1861 (Name only).
- Gasterosteia dekayi* Sauvage, Revision des Epinoches, 31, 1874 (New York).
- Gasterosteia blanchardi* Sauvage, Revision des Epinoches, 32, 1874 (New York); Bean, Proc. U. S. Nat. Mus., 1879, 31 (Boston).

1 a. *P. pungitius brachypoda*.

- Gasterosteus pungitius brachypoda* Bean, Bull. U. S. Nat. Mus., xv, 129, 1879 (Osooadlin—Mountain Streams and Lakes); Bean, Proc. U. S. Nat. Mus., 1880, 77 (American Harbor); Bean, Arctic Cruise, 118, 1881 (Elephant Point, near Icy Cape); Bean, Proc. U. S. Nat. Mus., 1881, 240 (St. Paul, Kodiak; Unga Island, Shumagins; Iliuliuk Lake, Unalaska; St. Paul Island, Bering Sea; St. Michaels; Port Clarence; Elephant Point; Eschscholtz Bay; Icy Cape, Arctic Ocean; Alaska; Bean, Proc. U. S. Nat. Mus., 1881, 270 (Pacific South of Bering Strait); Jordan & Gilbert, Syn. N. A. Fish., 394, 1883; Bean, Bull. U. S. Nat. Mus., xxi, 19, 1883 (St. Michaels, Alaska).
- Gasterosteus pungitius* Stejneger, Proc. U. S. Nat. Mus., 1883, 65 (Commander Islands).

Habitat.—Shores of Northern Europe and Eastern America South to New York, also in the great Lakes and northward; var. *brachypoda* in the North Pacific, the specimens examined by me are from Calumet Lake, Ills., and from Massachusetts.

The synonymy of this species, as given above, needs a word of remark.

The *pungitivus* of Walbaum is of course identical with the *pungitius* of Linnæus.

I cannot see that east coast specimens, representing the *occidentalis* of Cuvier and Valenciennes, and that of Dekay, differ

at all from descriptions of the European *pungitius*, but I have had no specimens of the latter for direct comparison. I cannot, therefore, regard *occidentalis* as a separate species or variety. The *dekayi* of Agassiz is based on the *occidentalis* of Dekay; I have therefore placed it also in the synonymy of *pungitius*.

The *mainensis* of Storer is said to differ from *pungitius* only in having a "bony serrated plate on the side." This probably refers to the plate behind the pectorals.

The *concinus* of Richardson is said to differ in having seven dorsal spines, but as the number seems to vary from 7 to 11, this cannot be considered as a specific character. I have examined specimens from Calumet, R. Illinois (presumably representing the form called *nebulosus*). I can find no difference whatever between these and Massachusetts examples of *pungitius*.

The var. *brachypoda* seems to differ from *pungitius* only in the shorter ventral spines. It is known to me only from the description of Dr. Bean (above cited).

2. EUCALIA.

Eucalia Jordan, Man. Vert., ed. i, 248, 1876 (*inconstans*).

This genus is closely allied to *Pygosteus*, agreeing with it in the structure of the gill membranes, but differing in having the dorsal spines few and non-divergent, and in having the innominate bones more fully united. The species are the most feebly armed of the Sticklebacks.

Analysis of Species of Eucalia.

- a. Body moderately robust, the caudal peduncle not very slender; depth 4 in length to base of caudal. Head pointed; mouth small, very oblique; maxillary reaching to anterior margin of eye; teeth small, stout, in a single series; eye large, much longer than snout. Caudal peduncle moderately compressed, $7\frac{1}{2}$ times in length to base of caudal. No bony dermal plates; skin naked; no post-opercular (suprascapular) plate; post-pectoral plate covered by skin; skin of head not ossified. Lateral line beginning at upper angle of preopercle and curved to below fourth dorsal spine, from where it goes straight to middle of tail; a second row of tubes is seen for a small distance along its origin. A patch of mucous pores at beginning of lateral line; a row along the edge of the preopercle and a C-shaped

row at nape. Dorsal spines about equal to one-half diameter of eye, the first just reaching base of second; these spines are recurved and slightly serrate on their edges; the fifth spine is more recurved and higher than the others. Soft dorsal very high in front, its longest ray about equal to snout and half the orbit; the last ray equals half the orbit; caudal short and broad; anal inserted below insertion of second dorsal, similar to and coterminous with it. Pectorals short and broad, their length equal to their breadth at tips. Vertebrae (*cayuga*), 14 + 18. Brownish with lighter blotches and black points. Males in spring black, tinged with red on the jaws and snout.

- b. Ventral spines equal to $\frac{2}{3}$ length of innominate bones; post-pectoral plate large, variable, mostly ∇ -shaped. D. IV-I, 10; A. I, 10. INCONSTANS. 2.
- bb. Ventral spines short, but longer than innominate bones; post-pectoral smaller than in preceding; mostly Π -shaped. D. IV-I, 10; A. I, 10. *cayuga*. 2 (a).
- bbb. "D. III or IV-I, 6. A. I, 6." (?). *pygmæa*. 2 (b).

2. EUCALIA.

2. *E. inconstans*.

Gasterosteus inconstans Kirkland, Boston Journal Nat. Hist., iii, 273, 1841 (Trumbull Co., Ohio); Dekay, Nat. Hist. N. Y., 68, 1842 (Name only); Cope, Proc. Acad. Nat. Sci. Phila., 1865, 81 (Sukertoppen, Greenland); Jordan & Gilbert, Syn. Fish. N. A., 394, 1883.

Apeltes inconstans Jordan, Fish of Indiana, 31, 1874 (Northern Indiana).

Eucalia inconstans Jordan, Man. Vert., ed. i, 249, 1876 (Name only); Jordan & Copeland, Checklist N. A. Fresh-water Fish, 141, 1876 (Name only); Nelson, Bull. Ills. Tab. Nat. Hist., i, 42, 1876 (Copied); Jordan, Bull. Ills. Lab. Nat. Hist., ii, 58, 1877 (Small Streams of Northern Ills.); Jordan, Proc. Acad. Nat. Sci. Phila., 1877, 65; Jordan, Cat. Fresh-water Fish N. A., 441, 1878 (Name only); Forbes, Bull. Ills. Lab. Nat. Hist., iii, 68, 1880 (Northern Ills.).

Gasterosteus micropus Cope, Proc. Acad. Nat. Sci. Phila., 1865, 81 (Fort Riley, Kansas); Sauvage, Revision des Epinoches, 28, 1874 (Copied).

Eucalia micropus Jordan & Copeland, Checklist N. A. Fresh-water Fish, 141, 1876 (Kansas).

Gasterosteus globiceps Sauvage, Revision des Epinoches, 35, 1874 (North America).

Eucalia inconstans, var. *pygmæa* Jordan, Geol. Report Ohio, 998, 1882 (Central Ohio; Trib. of Great Lakes).

2 a. *E. inconstans cayuga*.

Eucalia inconstans, var. *cayuga* Jordan, Man. Vert., ed. i, 249, 1876 (Cayuga Lake); Jordan & Copeland, Checklist N. A. Fresh-water Fish, 141, 1876 (Name only); Jordan, Geol. Report Ohio, 998, 1882.

2 b. *E. inconstans pygmæa*.

Gasterosteus pygmæus Agassiz, Lake Superior, 314, 1850 (Lake Superior).

Eucalia inconstans, var. *pygmæa* Jordan, Man. Vert., ed. i, 249, 1876 (Copied); Jordan & Copeland, Checklist N. A. Fresh-water Fish, 141, 1876 (Name only); Nelson, Bull. Ills. Lab. Nat. Hist., i, 42, 1876 (Lake Michigan).

Habitat.—Fresh waters of North America, from Kansas and Great Lake region northward to Greenland. Var. *cayuga* in tributaries of Lake Ontario. Var. *pygmæus* in Great Lakes.

The specimens of the typical *inconstans* examined by me are from Rock River, Illinois.

Those of the var. *cayuga* are from Syracuse, New York.

The *micropus* of Cope would seem to differ in its shape, being shorter and deeper, and in having a smaller post-pectoral plate and ventral spines. All of these characters are of doubtful permanence.

The *globiceps* of Sauvage offers no peculiar characters.

The var. *cayuga* seems to differ from *inconstans* in having longer ventral spines and smaller post-pectoral plates; it is perhaps identical with it.

The *pygmæa* of Agassiz is said to differ from *inconstans* in having the body shorter and deeper, and in the number of fin rays. The difference in form is of no importance, and it is not likely that the alleged difference in the fin rays is real.

3. *GASTEROSTEUS*.

Gasterosteus Artedi, Gen. Pisc., 52, 1738.

Gasterosteus Linnæus, Syst. Nat. Ed. x, i, 295, 1758 (*aculeatus*).

Gasteracanthus Pallas, "Zoogr. Rosso. Asiatica, iii, 228," 1811 (*catapharactus*).

Leiurus Swainson, Nat. Hist. Class Fishes, ii, 242, 1839 (*gymnurus*, etc.).

This genus is distinguished from *Pygosteus* and *eucalia* in having the posterior margin of the gill membrane joined to the isthmus. The body is more robust; the spines and innominate bones much stronger; the pubic bones very broad and little divergent. Its species are the strongest of the sticklebacks and the most

fully armed. All of them are very variable and very closely related one to another. The species with the bony plates most developed are most marine in their habit, while the partly or wholly naked forms seem rather to inhabit the rivers. It may be that a complete gradation exists from the fully armed *aculeatus* to the naked *williamsoni*, in which case all these forms should be regarded as varieties of *aculeatus*. All northern regions seem to possess full mailed species (*aculeatus* and vars.) and half mailed species (allies of *gymnurus*). The former type seems identical on both sides of the Atlantic, but the latter type so far as our specimens can show seems to be different in America from any described in Europe.

Analysis of Species of Gasterosteus.

a. Sides entirely covered with (28 to 30) bony dermal plates.

Caudal peduncle keeled; ventral spines each with a large cusp on outer edge of base. Bones of head striate, the skin ossified. Mouth large, little oblique; maxillary not reaching front of eye; teeth small, in a single series in lower and double series in upper jaw. The anterior plates are joined above to the large bony plates at base of spines; the posterior plates are separated from the small plates at bases of soft dorsal and anal by narrow naked strips. Lateral line high up, parallel with outline of back and along middle of caudal peduncle, which is strongly keeled. Dorsal spines serrate on their edges. Origin of soft dorsal far in advance of origin of anal. Caudal lunate; anal spine recurved, smaller than third dorsal spine, the fin similar to soft dorsal. Ventrals long and slender, serrate. Pectorals narrow. D. I-I-I, 11 to 13; A. I, 9 or 10.

b. Body moderately robust, the depth $4\frac{1}{2}$ in length.

ACULEATUS. 3.

bb. Body deeper and stronger; caudal keel very strong.

CATAPHRACTUS. 3. (*a.*)

aa. Sides partly covered with (2 to 15) bony dermal plates, the posterior part of the body naked. Ventral spines with or without cusp at base.

c. Sides with 15 bony plates; caudal peduncle keeled; body slender; ventral spine long, almost or quite reaching vent; dorsal spines in a straight line. Head $3\frac{1}{3}$ in length to base of caudal; depth 5. D. I-I-I, 11; A. 1, 8. Silvery below with dark bands across the body (*Bean*). ATKINSII. 4.

cc. Sides with 2 to 6 bony dermal plates; caudal peduncle keeled or not.

d. Ventral spine without cusp at base.

e. Dermal plates 4 to 6; body stout, little compressed; head large, flat above, a small knob at occiput. Mouth large, maxillary almost reaching front of orbit. Teeth in broad bands in front. From occiput, two rows of mucous pores diverge to posterior borders of eye, extending thence parallel with the orbit to above nasal opening forming an arrow-shaped figure. Plates on sides imbedded, thin; striate; the last one immediately in front of second dorsal spine. Post-pectoral plate striate \cap -shaped. Scapula forming a striate post-opercular plate. Caudal peduncle very thick to a point immediately in front of caudal where it is much compressed. Innominate bones and ventrals varying much in relative length, so that in some specimens the one is the longer in others the other. Dorsal spines short, straight, broad at base, serrate on outer edges. First spine about $\frac{2}{3}$ in eye, third very small. Caudal slightly lunate. Anal inserted under fifth dorsal ray, coterminous with the dorsal. Ventrals coarsely serrate on outer and finely on inner edges. Pectorals broad and short, fan-shaped. D. I-I-I, 11 to 13; A. 1, 9. Olivaceous, silvery below, thickly punctulate.

MICROCEPHALUS. 5.

ee. Dermal plates on side 2 or 3, strong, not imbedded. Mouth large, maxillary reaching to below front of orbit. Mucous pores none. Scapula forming a post-opercular plate. All bones thicker and stronger than in *microcephalus*. Caudal peduncle compressed for its whole length.

D. I-I-I, 10 to 12; A. 1, 8.

WHEATLANDI. 6.

dd. Ventral spines each with a distinct cusp at base. Lower jaw the longer. Teeth in lower jaw stronger than in upper. Diameter of orbit $3\frac{1}{2}$ in head. Sides with 7 plates. Innominate bones almost reaching vent. Caudal peduncle with a membranous carina. Caudal fin forked. Ventral $\frac{1}{3}$ in. finely serrate. Pectoral $\frac{1}{2}$ in. Length of specimen $2\frac{1}{2}$. D. I-I-I, 12; A. 1, 8. Uniformly grayish on back, head and posterior half of body; abdomen yellowish.

DIMIDIATUS. 7.

aaa. Sides entirely naked; no bony dermal plates; caudal peduncle not keeled. Tip of first dorsal spine not reaching second. Head 3 in length to base of caudal. Depth 5 in total length. D. I-I-I-1, 10; A. 1, 7. Olivaceous brown, darker above; sides spotted with black; belly yellowish. WILLIAMSONI. 8.

3. GASTEROSTEUS.

3. *G. aculeatus*.

Gasterosteus in dorso tribus. Artedi, Gen. Pisc., 52, 1738 (Europe); Pennant, Arctic Zool., ii, 385, 1792 (No description).

Gasterosteus aculeatus Linnæus, Syst. Nat. Ed. X, i, 295, 1758 (after Artedi); Fabricius, "Fauna Grœnlandica," 169, 1780 (Greenland); Bloch, Syst. Nat., plate 53, fig. 3; Richardson, Fauna Bor. America, 55, 1836; Gill, Cat. Fish. East Coast N. A., 39, 1861 (Name only); Gill, Cat. Fish. East Coast N. A., 16, 1873 (Name only); Sauvage, Revision des Epinoches, 9, 1874 (Bonneville, near Caen); Jordan, Cat. Fresh Water Fish. N. A., 442, 1878 (Name only); Goode & Bean, Fish. Essex Co. Mass. Bay, 5, 1879 (Essex Co.); Bean, Proc. U. S. Nat. Mus., 1880, 77 (Woods Holl, Wilmington, Del.); Jordan & Gilbert, Syn. Fish. N. A., 395, 1883 (East Coast); Stearns, Proc. U. S. Nat. Mus., 1883, 123 (Labrador).

Gasterosteus bispinosus Walbaum, Artedi Ichth., 450, 1792 (after Pennant).

Gasterosteus biaculeatus Shaw, Zool., iv, 608, 1839 (after Pennant); Mitchill, Trans. Lit. and Phil. Soc., 430, 1814 (Salt Water at New York); Dekay, Nat. Hist. N. Y., 65, plate iii, fig. 8, 1842 (New York); Storer, Syn. Fish. N. A., 63, 1846; H. R. Storer, Fish. Labrador, 260, 1849 (Brooks emptying into Gut of Canso); Gill, Cat. Fish. East Coast N. A., 39, 1861 (Name only); Putnam, Bull. Mus. Comp. Zool., 11, 1863; Storer, Hist. Fish. Mass., 87, plate viii, fig. 213, 1867.

Gasterosteus noveboracensis Cuvier & Valenciennes, Hist. Nat. Poissons, iv, 502, 1829 (New York); Storer, Rept. Fish. Mass., 30, 1839 (Massachusetts); Ayres, Fish. Brookhaven, Long Island, 259, 1842 (Old Man's Harbor, Storer, Syn. Fish. N. A., 63, 1846; Gill, Cat. Fish. East Coast N. A., 16, 1873 (Name only); Sauvage, Revision des Epinoches, 11, 1874 (New York, Newfoundland, Boston); Jordan, Man. Vert., Ed. i, 250, 1876 (Name only); Goode, Bull. U. S. Nat. Mus., xiv, 53, 1879 (Name only).

Gasterosteus aculeatus var. *noveboracensis* Günther, Cat. Fish. Brit. Mus., i, 4, 1859 (Greenland).

Gasterosteus niger Cuvier, Règne Animal, 76, 1829 (Based on *biaculeatus* of Mitchill); Cuvier & Valenciennes, Hist. Nat. Poissons, iv, 503, 1829 (Newfoundland); Dekay, Nat. Hist. N. Y., 68, 1842 (Newfoundland); Storer, Syn. Fish. N. A., 63, 1846; Gill, Cat. Fish.

East Coast N. A., 39, 1861 (Name only); Sauvage, Revision des Epinoches, 13, 1874 (Newfoundland); Jordan, Cat. Fresh Water Fish. N. A., 442, 1878 (Name only).

Gasterosteus trachurus Cuvier, Règne Animal, 76, 1829 (Based in part on Bloch); Storer, Syn. Fish. N. A., 62, 1846.

Gasterosteus loricatus Reinhardt, Grøn. Fauna, 37, 1837 (Greenland); Reinhardt, "Kong. Danske. Vidensk. Selsk. Nat. Math. Afh., vii, 114," 1838; Sauvage, Revision des Epinoches, 12, 1874 (Newfoundland).

Gasterosteus neboracensis Dekay, Nat. Hist. N. Y., 66, plate vi, fig. 17, 1842 (New York).

Gasterosteus dekayi Ayres, Proc. Ac. Nat. Sci. Cal. (based on *biaculeatus* of Dekay).

Gasterosteus suppositus Sauvage, Revision des Epinoches, 11, 1884 (after Dekay).

3. *G. aculeatus cataphractus*.

Gasteracanthus cataphractus Pallas, "Mem. Acad. Petersb., iii, 325," 1811.

Gasterosteus cataphractus Bean, Proc. U. S. Nat. Mus. 1881, 239 (Kodiak, Cook's Inlet, Sitka, Port Mulgrave, Shumagins, Unalaska, Amchitka, Kyska Harbor, St. Paul, Bering Sea near Bering Isl.); Bean, Proc. U. S. Nat. Mus., 1881, 270 (Pacific South of Bering Strait, Puget Sound, San Francisco); Stejneger, Proc. U. S. Nat. Mus., 1883, 65 (Commander Island); Bean, Proc. U. S. Nat. Mus., 1883, 353 (Duncan's Bay, Brit. Col.); Bean, Cat. Fish. in Internat. Fish. Exhib. London, 19, 1883 (St. Paul Isl.).

Gasterosteus aculeatus var. *cataphractus* Jordan & Jouy, Proc. U. S. Nat. Mus., 1881, 1 (Puget Sound); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 69 (San Francisco to Alaska).

Gasterosteus aculeatus subsp. *cataphractus* Jordan & Gilbert, Syn. Fish. N. A., 396, 1883 (West Coast).

Gasterosteus obolaris Cuvier & Valenciennes, Hist. Nat. Poissons, iv, 500, 1829 (Kamtschatka); Sauvage, Revision des Epinoches, 12, 1874 (Name only).

Gasterosteus insculptus Richardson, Last Arctic Voy., 10, plate xxv, fig. 1, 2, 3, 1854 (Northumberland and Puget Sound); Bean, Bull. U. S. Nat. Mus., xv, 129, 1879 (Northumberland Sound).

Gasterosteus serratus Ayres, Proc. Cal. Acad. Nat. Sci., 1855, 47 (San Francisco); Girard, Pacific R. R. Survey, 88, 1859 (Shoal Water Bay: San Francisco); Sauvage, Revision des Epinoches, 13, 1874 (San Francisco Bay); Jordan, Cat. Fresh Water Fish. N. A., 442, 1878 (Name only); Jordan & Gilbert, Proc. U. S. Nat. Mus. 1880, 452 (Puget Sound, San Francisco); Jordan & Jouy, Proc. U. S. Nat. Mus., 1881, 1 (Foot note).

Gasterosteus intermedius Girard, Proc. Acad. Nat. Sci. Phila., 1856, 135;
Girard, Pacific R. R. Survey, 89, 1859 (Cape Flattery); Jordan, Cat.
Fresh-water Fish N. A., 442, 1878 (Name only).

Habitat.—Northern Atlantic Coast of both Continents. Var. *cataphractus* is found on the West Coast of North America, from San Francisco to Alaska and Kamtschatka.

This species differs from the others in having the whole sides covered with (28–30) bony plates.

The *biaculeatus* of Mitchill possesses the (33) plates characterizing the *aculeatus* and otherwise agrees with the latter; the slight variation in the number of lateral plates may perhaps arise from a different manner of counting them.

The *bispinosus* of Walbaum and *biaculeatus* of Shaw are alike based on Pennant. The description given by the latter author is of very little importance, but the probabilities all favor that the species he had in mind was *Gasterosteus aculeatus*.

The *noveboracensis* of Cuvier and Valenciennes is said to differ from *aculeatus* in the position of the lateral line and in the stronger caudal keel. Neither of these features is likely to be of specific value, and I therefore place it in the synonymy of *aculeatus*.

The *niger* of Cuvier is based on the *biaculeatus* of Mitchill, which is *aculeatus*. The *trachurus* of the same author has the sides completely covered with plates, and is, of course, the ordinary European form of *aculeatus*.

The *suppositus* of Sauvage is a supposed new species described by Dekay as *neoboracensis*, but the *neoboracensis* of Dekay is identical with the *noveboracensis* of Cuvier and Valenciennes, and *suppositus* is therefore a synonym of *aculeatus*. The figure of Dekay has lateral plates extending from the post-pectoral plate to the caudal, but as this differs from the nature of the armature of this group, and as Dekay does not mention the naked area about the ventral region and gives the number of the plates as 30 to 33, these discrepancies must be due to a mistake of the artist.

The *Gasterosteus texanus* of Sauvage is somewhat different. It has eleven plates extending to the second ray of the soft dorsal; thence to the last ray, the body is naked, the peduncle being again mailed and strongly keeled. As no sticklebacks are found much south of the Great Lake region, it is very probable that the type of *G. texanus* did not come from Texas. At

present I place *texanus* in the synonymy of *aculeatus*, the peculiarities above mentioned being perhaps due to mutilation.

The many specimens examined by me are from Wilmington, Delaware, and from Woods Holl, Massachusetts.

The var. *cataphractus* differs from *aculeatus* in its deeper and shorter form. Northern specimens are larger and more robust than those found further south, and it is not likely that with a large series any tangible permanent differences could be maintained.

The names *cataphractus* and *obolarius* were given to Alaskan specimens; the *insculptus* from the Arctic is not essentially different, and the *serratus* of Ayres and *intermedius* of Girard, from further south, are also certainly the same.

The large collections made by Jordan and Gilbert of the West Coast of the U. S., show conclusively that not more than two distinct forms of Sticklebacks, *cataphractus* and *microcephalus*, exist on that coast.

4. *Gasterosteus atkinsii*.

Gasterosteus atkinsii Bean, Proc. U. S. Nat. Mus., 1879, 67 (Schoodic Lakes); Jordan & Gilbert, Syn. Fish. N. A., 395, 1882 (Copied).

Habitat.—Schoodic Lakes, Maine.

This species is characterized by the presence of 15 lateral plates; it is therefore intermediate between the full armed *aculeatus* and the partly mailed *gymnurus*, etc. The species is known to me from the description of Bean (*loc. cit.*). This description indicates some affinity with the European *Gasterosteus semiarmatus*, which has also 14 (12 to 15) plates.

5. *Gasterosteus microcephalus*.

Gasterosteus microcephalus Girard, Proc. Ac. Nat. Sci. Phila., 1854, 133; Girard, Pacific R. R. Survey, 91, 1859 (Tulare Valley); Sauvage, Revision des Epinoches, 22, 1874 (Tulare Valley); Jordan, Cat. Fresh-water Fish N. A., 442, 1878 (Name only); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 453 (Puget Sound; San Francisco; Monterey Bay; San Pedro); Jordan & Jouy, Proc. U. S. Nat. Mus., 1881, 1 (San Francisco); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 69 (Los Angeles to Puget Sound); Bean, Proc. U. S. Nat. Mus., 1881, 240 (Piseco Lake, Sitka; St. Paul, Kodiak; Chirikoff Isl.; Iliuliuk Unalaska); Bean, Proc. U. S. Nat. Mus., 1881, 270 (Pacific, south of Bering Strait; Puget Sound; San Francisco); Jordan & Gilbert, Syn. Fish. N. A., 395, 1882; Rosa Smith, Proc. U. S. Nat. Mus., 1883, 217 (Name only); Rosa Smith, Proc. U. S. Nat. Mus., 1883, 233 (Todos Santos Bay); Bean, Proc. U. S. Nat. Mus., 1883, 353 (Mountain Lake, Alaska); Bean, Cat. Fish. in Internat. Fish. Ex. London, 19, 1883 (St. Paul, Kodiak).

Gasterosteus plebeius Girard, "Proc. Ac. Nat. Sci. Phila., 1854, 147;" Girard, Pacific R. R. Survey, 86, 1859 (San Francisco; San José; Petaluma); Sauvage, Revision des Epinoches, 18, 1874 (Petaluma); Jordan, Cat. Fresh-water Fish. N. A., 442, 1878 (Name only).

Gasterosteus inopinatus Girard, "Proc. Ac. Nat. Sci. Phila., 1854, 147;" Girard, Pacific R. R. Survey, 90, 1859 (Presidio); Sauvage, Revision des Epinoches, 19, plate i, fig. 4, 1874 (Presidio Creek, Cal.); Jordan, Cat. Fresh-water Fish N. A., 442, 1878 (Name only).

Gasterosteus pugetti Girard, "Proc. Ac. Nat. Sci. Phila., 1856, 135;" Girard, Pacific R. R. Survey, 92 and 354, 1859 (Puget Sound); Jordan, Cat. Fresh-water Fish N. A., 442, 1878 (Name only).

Habitat.—Pacific Coast North America, from Bering Strait south to Todos Santos Bay. Ascends rivers.

This species differs from *dimidiatus* in having no cusp at base of ventrals and no caudal keel; it differs from *wheatlandi* in having all its bones much weaker and in the arrangement of the mucous pores about the head.

The collection of Jordan and Gilbert shows that all naked-tailed Sticklebacks (*microcephalus*, *plebeius*, *inopinatus* and *pugetti*) belong to one species.

It is possible, as several writers have affirmed, that all these naked-tailed Sticklebacks (*gymnurus*, *microcephalus*, *wheatlandi*, *williamsoni*) are simple varieties of the ordinary *G. aculeatus*. It seems to me that the peculiarities of the Californian form are so constant that we may regard this one at least as presenting a distinct species. Of *G. wheatlandi* and *gymnurus* I am not so certain, but I have not yet seen any distinctly intermediate forms, although all these types, like all other Sticklebacks, are subject to much individual variation. The characters given in the analysis above are to be regarded as simply provisional, as representing the differences shown by the material at my disposal.

The specimens examined by me are from San Diego, Cal.

6. *Gasterosteus wheatlandi*.

Gasterosteus wheatlandi Putnam, "Proc. Essex Inst., v. 4, 1867;" Storer, Hist. Fish. Mass., 254, 1867 (Nahant).

Gasterosteus trachurus Goode & Bean, Fishes of Essex Co. and Mass. Bay, 5, 1879 (Nahant, not *G. trachurus* of Cuvier).

Habitat.—East Coast United States, northward.

This species differs from *G. microcephalus* in having stronger surface bones, no mucous pores about the head, and the caudal peduncle compressed.

The specimens examined by me are from the coast of Massachusetts.

7. *Gasterosteus dimidiatus*.

Gasterosteus biaculeatus Cuvier & Valenciennes, Hist. Nat. Poissons, iv, 503, 1829 (Newfoundland, not *G. biaculeatus* of Shaw); Günther, Cat. Fish. Brit. Mus., i, 5, 1859 (Coast Newfoundland and Labrador); Gill, Cat. Fish. East Coast N. A., 16, 1873 (Name only); Sauvage, Revision des Epinoches, 21, 1874 (Newfoundland); Jordan, Cat. Fish. N. A., 442, 1878 (Name only); Jordan & Gilbert, Syn. Fish. N. A., 395, 1883; Stearns, Proc. U. S. Nat. Mus., 1883, 123 (Labrador).

Gasterosteus dimidiatus Reinhardt, Grøn. Faun. 37, 1837 (Greenland); Reinhardt, "Kong. Dansk. Vidensk. Selsk. Nat. og. Math. Afhand. vii, 193," 1838; Sauvage, Revision des Epinoches, 28, 1874 (Name only).

Gasterosteus aculeatus var. *dimidiatus* Gill, Cat. Fish. East Coast N. A., 39, 1861 (Name only).

Gasterosteus cwiieri (Girard MSS.) Storer, H. R. Fish. Nova Scotia and Labrador, 254, plate vii, fig. 1, 1849 (Bras d'Or, Red Bay).

Habitat.—East Coast North America, northward.

This species differs from its nearest relations in having a cusp at the base of the ventrals and a fleshy caudal carina.

The name *biaculeatus* cannot be retained for this species, as it was originally based on a description of Pennant which apparently refers to *G. aculeatus*.

I have examined no specimens of this species, and I am not sure that it differs in any important respect from the naked tailed sticklebacks (*G. gymnurus* Cuvier = *G. leiurus* Cuv. and Val.) of Europe.

8. *Gasterosteus williamsoni*.

Gasterosteus williamsoni Girard, "Proc. Acad. Nat. Sci. Phila., 133," 1854 (Williamson Pass); Girard, Pacific R. R. Survey, 93, 1859 (Williamson Pass); Sauvage, Revision des Epinoches, 25, 1874; Jordan, Cat. Fresh Water Fish. N. A., 441, 1878; Jordan & Gilbert, Syn. Fish. N. A., 393, 1883; Rosa Smith, Proc. U. S. Nat. Mus., 1883, 217 (Artesian well at San Bernardino).

Eucalia williamsoni Jordan & Copeland, Checklist Fresh Water Fish. N. A., 141, 1876.

Habitat.—Streams of California.

This species differs from the other species of this genus in having no lateral plates. Miss Rosa Smith records one from an artesian well in California and pronounces it a true *Gasterosteus* and not a *Eucalia*.

The species is known to me from Girard's description in the Pacific R. R. Survey, and from the account given by Miss Smith.

4. APELTES.

Apeltes Dekay, Nat. Hist. N. Y., 67, 1842 (*quadracus* no description).

Apeltes Jordan, Man. Vert., 249, 1876 (Characterized).

This genus is distinguished by the form and position of the innominate bones, these being separated and forming subdermal spines on the outer edges of the abdomen. The pubic bones are small and weak, not visible on surface. It is a more sharply defined group than *Eucalia* or *Pygosteus* and its single species has shown no important variation.

Analysis of Species of Apeltes.

- a. Trunk oblong; head pointed; caudal peduncle slender, not keeled. Mouth small, horizontal; maxillary not reaching to eye; teeth slender, in a single series. No bony dermal plates along sides. Scapula forming a small granulated post-opercular plate. Innominate bones wide apart; the area between them flat so that a section of the fish is triangular. Gill membrane broadly united to the isthmus. Free dorsal spines divergent. The spines slender, pointed, slightly serrate. Distance between first and third spine much less than that between third and fourth; the first extending beyond base of third. Caudal long, narrow; anal similar to soft dorsal and coterminous with it; its spine under third ray of dorsal. Ventral spines strong, subterete; serrate on both edges and covered by skin to near tip. When ventral spines are set they point almost sidewise, when depressed they lie along inside of innominate bones. **QUADRACUS. 9.**

9. *Apeltes quadracus.*

Gasterosteus quadracus Mitchill, Trans. Lit. and Phil. Soc., i, 430, 1814; Cuvier & Valenciennes, iv, 504, 1829 (Newfoundland); Storer, Rept. Fishes Mass., 31, 1839 (Salem); Dekay, Nat. Hist. N. Y., 67, plate vi, fig. 18, 1842 (New York); Storer, Syn., 63, 1846; Baird, Fish. of N. Jersey Coast, 14, 1855 (Salt Ponds of New Jersey); Storer, "Mem. Am. Ac. New Series, ii, 315;" Storer, Fish. Mass., 89, plate viii, fig. 4, 1867 (Massachusetts); Günther, Cat. Fish. Brit. Mus., i, 7, 1859 (copied); Sauvage, Revision des Epinoches, 27, 1874 (copied).

Apeltes quadracus Putnam, "Proc. Essex Inst., 1855, 148," Brevoort in Gill's Cat. Fish. East Coast N. A., 39, 1861 (Name only); Gill, Cat. Fish. East Coast N. A., 16, 1873 (Name only); Jordan, Man. Vert. Ed., i, 249, 1876 (copied); Jordan & Copeland, Checklist Fresh Water Fish. N. A., 141, 1876 (East Coast); Jordan, Cat. Fresh Water Fish. N. A., 441, 1878 (Name only); Goode & Bean, Fish. Essex Co. and Mass. Bay, 5, 1879 (Salem and vicinity); Goode, Bull. U. S. Nat. Mus., xiv, 54, 1879 (Name only); Goode, Bnll. U. S. Nat. Mus., xxi,

31, 1880 (Name only); Bean. Proc. U. S. Nat. Mus., 1880, 77 (Woods Holl, Noank); Jordan & Gilbert, Syn. Fish. N. A., 396, 1883.

Gasterosteus apelles Cuvier & Valenciennes, Hist. Nat. des Poiss., iv, 505, 1829 (No locality); Storer, Rept. Fish. Mass., 31, 1839 (Salem); Sauvage, Revision des Epinoches, 26, plate i, fig. 13, 1874 (New York).

Gasterosteus millepunctatus Ayres, Boston Journ. Nat. Hist., 259 and 294, 1842 (Old Man's Harbor); Brevoort in Gill's Cat. Fish., East Coast N. A., 39, 1861 (Name only); Sauvage, Revision des Epinoches, 27, 1874 (copied).

Habitat.—Atlantic Coast of North America; Northward.

This species is easily distinguished by the separation of the innominate bones and by the four divergent dorsal spines.

The *apeltes* of Cuvier and Valenciennes does not differ from the *quadracus* of Mitchill.

The *millipunctatus* of Ayres is also identical with the *quadracus* of Mitchill.

The numerous specimens examined by me are from Woods Holl, Massachusetts.

5. SPINACHIA.

Spinachia Fleming, "Hist. Brit. Animals, 219," 1828 (*spinachia*).

Polycanthus Swainson, Fishes 175 and 242, 1839 (*spinachia*).

Gastræa Sauvage, Revision des Epinoches, 7, 1876 (*spinachia*).

This genus differs from the others in the prolongation of the snout which approaches in form the snout of *Aulorhynchus* and *Fistularia*. The innominate bones are as in *Apeltes*; there are about 15 free dorsal spines.

Analysis of the Species of Spinachia.

- a. Snout prolonged; dorsal spines about 15; dermal plates, 40; depth 10 in length; head about 4; a carina running entire length of lateral line; body five-sided; tail four-sided. Vertebræ 18 + 23; D. XV, 6 or 7; ventral, i, 2; A. I, 6 or 7.

Spinachia. 10.

10. *Spinachia spinachia*,

Gasterosteus spinachia Linnæus, Syst. Nat. Ed. X., 296, 1758 (based on Artedi) (and of authors generally).

Gastræa spinachia Sauvage, Revision des Epinoches, 36, 1876 (Newfoundland).

Habitat.—North Atlantic on both continents.

This species has been but once ascribed to America. Sauvage notes a specimen in the Museum at Paris which he said to be

from Newfoundland. This record needs verification, and is probably the result of an error in labeling.

COMPARATIVE MEASUREMENTS IN HUNDREDS OF LENGTH TO BASE
OF CAUDAL.

	Pungitius.	Inconstans.	Cayuga.	Aculeatus.	Microcephalus.	Wheatlandi.	Quadracus.
Depth of Body.	17	22	23	24	30	26	32
Caudal Peduncle,	18	16	16	12	10	14	20
Length of Head,	25	29	27	29	34	33	25
Interorbital space,	4	4.5	5			7	
Snout,		5	7				
Operculum,		10	8			11	
Orbit,	8	8	9	7	8	9	7
First Dorsal Spine from Snout, . .	27	32	29	36	42	40	30
Height,	6	6	4	9		9	11
Antecedent Spine,		7	6			3	
First ray,		11	11	13		14	
Last ray,		3	2				
Anal from Snout,	30	58	59	72	70	70	58
Height of Spine,		7	7	2		2	8
First ray,		13	13	12		12	
Last ray,		3	1				
Caudal,		13	15	middle 12 extern 16	15 17	15 17	16
Pectoral from Snout,		30	31	36	39	38	29
Length,		11	11	20	15	17	17
Ventral from Snout,		40	41	43	44	45	33
Length,		9	7	14	14	13	16
Innominate bones,		12	5	17			

LIST OF NOMINAL SPECIES OF GASTEROSTEIDÆ, ARRANGED IN
CHRONOLOGICAL ORDER, WITH IDENTIFICATION.

(Tenable Specific Names are in *Italics*.)

<i>Nominal Species.</i>	<i>Date.</i>	<i>Identification.</i>
Gasterosteus <i>aculeatus</i> Linnæus,	1758,	Gasterosteus aculeatus.
Gasterosteus <i>pungitius</i> Linnæus,	1758,	Pygosteus pungitius.
Gasterosteus <i>spinachia</i> Linnæus,	1758,	Spinachia spinachia.
Gasterosteus <i>pungitius</i> Walbaum,	1792,	Pygosteus pungitius.
Gasterosteus <i>bispinosus</i> Walbaum,	1792,	Gasterosteus aculeatus.
Gasterosteus <i>cataphractus</i> Pallas,	1811,	Gasterosteus cataphractus.

<i>Nominal Species.</i>	<i>Date.</i>	<i>Identification.</i>
<i>Gasterosteus quadracus</i> Mitchell,	1814,	<i>Apeltes quadracus.</i>
<i>Gasterosteus niger</i> Cuvier,	1829,	<i>Gasterosteus aculeatus.</i>
<i>Gasterosteus trachurus</i> Cuvier,	1829,	<i>Gasterosteus aculeatus.</i>
<i>Gasterosteus obolarius</i> Cuv. & Val.,	1829,	<i>Gasterosteus cataphractus.</i>
<i>Gasterosteus noveboracensis</i> Cuv. & Val.,	1829,	<i>Gasterosteus aculeatus.</i>
<i>Gasterosteus biaculeatus</i> Cuv. & Val.	1829,	<i>Gasterosteus dimidiatus.</i>
<i>Gasterosteus apeltes</i> Cuv. & Val.	1829,	<i>Apeltes quadracus.</i>
<i>Gasterosteus occidentalis</i> Cuv. & Val.	1829,	<i>Pygosteus pungitius.</i>
<i>Gasterosteus concinnus</i> Richardson,	1836,	<i>Pygosteus pungitius.</i>
<i>Gasterosteus mainensis</i> Storer,	1837,	<i>Pygosteus pungitius.</i>
<i>Gasterosteus loricatus</i> Reinhardt,	1837,	<i>Gasterosteus aculeatus.</i>
<i>Gasterosteus dimidiatus</i> Reinhardt,	1837,	<i>Gasterosteus dimidiatus.</i>
<i>Gasterosteus biaculeatus</i> Shaw,	1839,	<i>Gasterosteus aculeatus.</i>
<i>Gasterosteus inconstans</i> Kirtland,	1841,	<i>Eucalia inconstans.</i>
<i>Gasterosteus millepunctatus</i> Ayres,	1842,	<i>Apeltes quadracus.</i>
<i>Gasterosteus cuvieri</i> Girard,	1849,	<i>Gasterosteus dimidiatus.</i>
<i>Gasterosteus nebulosus</i> Agassiz,	1850,	<i>Pygosteus pungitius.</i>
<i>Gasterosteus de kayi</i> Agassiz,	1850,	<i>Pygosteus pungitius.</i>
<i>Gasterosteus pygmaeus</i> Agassiz,	1850,	<i>Eucalia inconstans.</i>
<i>Gasterosteus insculptus</i> Richardson,	1854,	<i>Gasterosteus cataphractus.</i>
<i>Gasterosteus microcephalus</i> Girard,	1854,	<i>Gasterosteus microcephalus.</i>
<i>Gasterosteus williamsoni</i> Girard,	1854,	<i>Gasterosteus williamsoni.</i>
<i>Gasterosteus plebeius</i> Girard,	1854,	<i>Gasterosteus microcephalus.</i>
<i>Gasterosteus inopinatus</i> Girard,	1854,	<i>Gasterosteus microcephalus.</i>
<i>Gasterosteus serratus</i> Ayres,	1855,	<i>Gasterosteus cataphractus.</i>
<i>Gasterosteus intermedius</i> Girard,	1856,	<i>Gasterosteus cataphractus.</i>
<i>Gasterosteus pugetti</i> Girard,	1856,	<i>Gasterosteus microcephalus.</i>
<i>Gasterosteus atkinsii</i> Bean,	1859,	<i>Gasterosteus atkinsii.</i>
<i>Gasterosteus micropus</i> Cope,	1865,	<i>Eucalia inconstans.</i>
<i>Gasterosteus wheatlandi</i> Putnam,	1867,	<i>Gasterosteus wheatlandi.</i>
<i>Gasterosteus suppositus</i> Sauvage,	1874,	<i>Gasterosteus aculeatus.</i>
<i>Gasterosteus blanchardi</i> Sauvage,	1874,	<i>Pygosteus pungitius.</i>
<i>Gasterosteus globiceps</i> Sauvage,	1874,	<i>Eucalia inconstans.</i>
<i>Eucalia cayuga</i> Jordan,	1876,	<i>Eucalia cayuga.</i>
<i>Gasterosteus trachurus</i> Goode & Bean,	1879,	<i>Gasterosteus wheatlandi.</i>
<i>Gasterosteus brachypoda</i> Bean,	1879,	<i>Pygosteus brachypoda.</i>

RECAPITULATION.

In this review I have admitted 10 species and 5 genera of *Gasterosteidae* as valid. Below I give a list of the species. The general distribution of the species is indicated by the letters A. (America); E. (Europe); W. (West Coast of North America); P. (East Coast North America and Greenland); G. (Great Lake Region and Northward); U. (Western Slope of Rocky Mountains).

FAMILY **GASTEROSTEIDÆ.**Genus 1. **PYGOSTEUS** Brevoort.

1. *Pygosteus pungitius* Linnæus (E. A.). (P. G.).
- 1 a. *Pygosteus pungitius brachypoda* (W. U.). (Unknown to me).

Genus 2. **EUCALIA** Jordan.

2. *Eucalia inconstans* Kirtland (G. E.).
- 2 a. *Eucalia inconstans cayuga* Jordan (G.). (Variety of doubtful value).
- 2 b. *Eucalia inconstans pygmæa* Agassiz (Unknown to me; characters assigned perhaps erroneous).

Genus 3. **GASTEROSTEUS** Linnæus.

3. *Gasterosteus aculeatus* (E. A.) (P.).
- 3 a. *Gasterosteus aculeatus cataphractus* Pallas (W.). (Variety of doubtful value).
4. *Gasterosteus atkinsii* Bean (P.). (Unknown to me; perhaps local var. of *aculeatus*).
5. *Gasterosteus microcephalus* Girard (W.). (Possibly variety of *aculeatus*).
6. *Gasterosteus wheatlandi* Putnam (P.). (Perhaps var. of *aculeatus*).
7. *Gasterosteus dimidiatus* Reinhardt (P.). (Unknown to me; perhaps identical with *G. gymnurus*).
8. *Gasterosteus williamsoni* Girard (U.). (Possibly an extreme variety of *microcephalus* or *aculeatus*).

Genus 4. **APELTES** DeKay.

9. *Apeltes quadracus* Mitchill (P.).

Genus 3. **SPINACHIA** Fleming.

10. *Spinachia spinachia* Linnæus (E. P.). (Probably not American).